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DESIGN THINKING AS AN INNOVATIVE TEACHING METHOD FOR MEDIA AND COMMUNICATION COURSES

Dr. G. Suresh Kumar [1]

[1] Assistant Professor, Department of Visual Communication and Electronic Media, PSG College of Arts & Science, Coimbatore, India

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Corresponding Author

Dr. G. Suresh Kumar,
sureshself@gmail.com

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ABSTRACT

The objective of this research is to show how to design, implement, and establish how and why the Design thinking-based innovative teaching method is more effective. Following an action research method, a design thinking-based innovative pedagogy was introduced among the first-year postgraduate media students to teach a few modules of the course 'Television and Video Production'. An ill-defined story idea for an animated sci-fi television series was presented to student groups, and they were asked to develop upon the idea as well as provide some creative solutions to the problems. The entire activity was carried out in five different stages, such as Empathize, Define, Ideate, Prototype, and Test. At the end of the activity, the effectiveness of design thinking as an innovative method was analyzed. The findings suggest that design thinking was effective in imparting 21st-century skills, such as empathy, critical thinking, problem-solving, collaboration, creativity, and innovation.

Keywords: Design Thinking, Innovative Teaching Method, Media and Communication Courses, Action Research, 21st-Century Skills

1. INTRODUCTION

Rapid advancements in media technology, the emergence of new platforms, and new habits in media consumption have brought lots of challenges for media organizations Küng (2013), Friedrichsen et al. (2017). Innovation is imperative for media companies to cope with such dynamic shifts Bleyen et al. (2014), Weiss et al. (2018), Badillo and Bourgeois (2020). However, there exists an 'innovation gap' where students are not prepared to meet the requirements of the organizations Wallin et al. (2014). Trilling and Fadel (2009) conducted a study among 400 human resource executives and major corporations. They found that secondary and tertiary

level graduates lack seven basic and applied skills, which they termed as 21st century Gap. The skills identified were oral & written communication, critical thinking, and problem-solving skills, professionalism and work ethics, teamwork, and collaboration, working in diverse teams, applying technology, leadership, and project management Trilling and Fadel (2009).

There is also a widespread view that educational institutions should provide learners with skills and competencies to survive in a constantly changing occupational environment. According to Ponnan and Ambalavanan (2014), the current teaching methods, classroom practices, and single-skill training offered in schools and universities may no longer be relevant to industry expectations. Media organizations are looking for new competencies from their job entrants and renewed skills from their existing employees Ponnan and Ambalavanan (2014). Seechaliao (2017) investigated various learning strategies that facilitate creativity and innovation in education. The findings revealed that learning strategies such as design-based learning, problem-solving, creative problem solving, creative thinking, research-based learning, problem-based learning, and project-based learning support innovation in education. Also, using various stimulating ideas in problem-solving facilitates brainstorming and helps learners think about new ideas Seechaliao (2017). Hence, experiential learning and innovative thinking are crucial for the future career of today's students Deutschmann and Botts (2015), Spanjaard and Stegemann (2018).

Design Thinking (referred to as DT here onwards) as experiential learning gained popularity in recent years Gaskin and Berente (2011), Stock et al. (2018), Peck and De Sawal (2021). It is regarded as a model for increasing creativity and endurance, engagement, and innovation Dolak et al. (2013). This user-centered innovation method is increasingly used in professional consultancies, companies, and universities Thoring and Muller (2011), Deutschmann and Botts (2015), Brenner and Uebernickel (2016). Noel and Liub (2017) advocated that DT is an ideal choice for bridging the 21st-century gap identified by Trilling and Fadel. The skills that are necessary to bridge this gap are identical to the learning outcomes of design-based learning, which are learning and innovation skills, critical thinking and problem solving, communication and collaboration skills, and digital literacy Noel and Liub (2017).

A review of previous studies revealed that DT was used as an innovative teaching method in various educational settings, spanning from K12 to higher education Carroll et al. (2010). In higher education, the DT has been mostly applied in engineering and management courses Taajamaa et al. (2013), Withell and Haigh (2013), Ching (2014), Behm et al. (2014), Daniel (2016), Ranger and Mantzavinou (2018), Foster (2021), Kamrowska-Załuska and Parteka (2020), Avsec (2020). Further, its use is steadily on the rise in other educational contexts such as medical education, pharmacy education, tourism education, writing studies, and teacher education Thakur et al. (2020), Sandars and Goh (2020), Wolcott and McLaughlin (2020), Sandorova et al. (2020), Wible (2020), Henriksen et al. (2020). Few studies applied DT to teach courses in the media and communication stream Lugmayr et al. (2014), Yang and Hsu (2020), Fuente et al. (2019), Liu and Ko (2021), Ching-Jung (2021), Yilmaz (2021). However, the findings are not comprehensive enough to demonstrate the design, implementation, and effectiveness of the DT-based teaching method.

Hence, the aim of this study is twofold. The first aim is to share the knowledge of how to design and implement the DT-based innovative pedagogy in teaching a course 'Television and Video Production'. The second aim is to establish how and

why the DT approach is more effective. The study was conducted among the first-year postgraduate students of electronic media at the PSG College of Arts & Science, Coimbatore.

2. DESIGN THINKING: AN OVERVIEW

DT is a solution-oriented problem-solving method Pusca and Northwood (2018). It is very effective in solving complex problems that are ambiguous or unknown Cook and Bush (2018), Interaction design foundation (n. d). With the empathetic understanding of human needs, it provides creative solutions to complex problems by redefining them in human-centric ways, creating innovative solutions in brainstorming sessions, and adopting a practical approach to prototyping and testing Luka (2014), Reinecke (2016), Garrette et al. (2018). The entire process is non-linear and iterative Scheer et al. (2012), Kloeckner et al. (2017).

Nobel laureate Herbert Simon postulated one of the first models of DT in his seminal work 'The Sciences of the Artificial' in 1969. His pioneering model contains seven key stages. It was instrumental in framing many other DT process models used today. These models may have stages ranging from three to seven, but they are all developed from the principles featured in Simon's 1969 model. The study adopts the five-stage DT model proposed by the Hasso-Plattner Institute of Design at Stanford (d. school) because of its wider acceptance Plattner et al. (2011), Reinecke (2016). The five stages of the model are Empathize, Define, Ideate, Prototype, and Test (Table 1).

Table 1

Table 1 Design thinking Stages

DT Stages	Process
Empathize	Gaining insight into users and their needs through observations and research.
Define	Analysing the observations to redefine the core problem as a problem statement in a human-centred manner
Ideate	Thinking outside the box to identify new solutions to the problem statement
Prototype	Producing prototypes of the solutions generated in the Ideate stage
Test	Rigorous testing of each prototype to see how well it solves the core problem identified in the Define stage.

2.1. DESIGN THINKING AS AN INNOVATIVE TEACHING PEDAGOGY

In recent times, the popularity of DT as an innovative teaching pedagogy has been increasing in schools and higher education institutions Withell and Haigh (2013), Matthews and Wrigley (2017), Panke (2019), Beligatamulla et al. (2019). It has been regarded as an ideal choice for developing 21st-century skills among students Carroll et al. (2010), Luka (2014), Veerasinghan et al. (2021).

The theoretical foundation of DT is similar to Vygotsky's constructivist view of learning, where the learners construct their knowledge through social interactions with others Vygotsky (1976), Carroll et al. (2010), Kijima et al. (2021). In DT, the emphasis on improving communication and collaboration skills correlates with the core principles of a constructivist learning approach Kijima et al. (2021). In this context, several studies embraced DT to facilitate constructivist teaching and learning in educational institutions Scheer et al. (2012), Koh et al. (2015), Gross and Gross (2016), Pande and Bharathi (2020), and Kijima et al. (2021).

According to Beckman and Barry (2007), DT comprises all four phases of an ideal learning cycle. They are experiencing, reflecting, thinking, and acting. In a typical learning cycle, experiencing is attained through observations and reflections. These reflections are assimilated into abstract concepts which form new implications that are tested in action and impact the creation of new experiences again, thus confirming the feedback. The process of DT is analogous to this.

The basic nature of DT is also similar to the model of knowledge development elaborated by Owen (2007). According to him, in any field, knowledge is generated through action. The DT process occurs through analytic and synthetic stages. The analytic stage is a discovery stage, wherein the problem is located based on the review of the existing studies and observations. This stage is parallel to the stages of understanding, observing, and expressing a point of view in the knowledge development model. The synthetic stage is an idea generation stage, wherein providing solutions to the problem becomes the main focus. It occurs through ideation, prototyping, and testing stages in DT, which corresponds to the application stage in the knowledge development model.

Trilling and Fadel (2009) in their book "21st Century Skills" proposed a model for 21st-century learning. The model suggested an education setup with attributes such as diverse teams in problem-solving, technology infusion in curricula, real-world challenges, and project-based learning with an emphasis on innovation and creativity. These attributes are intrinsic aspects of a DT-based learning setup.

Ferguson et al. (2019) proposed ten key pedagogical innovations in their report 'Innovating pedagogy 2019. Playful learning, action-based learning, social and emotional learning (empathy), making thinking visible, and learning through wonder were among the innovative methods highlighted by them. Collectively, these methods are referring to DT-based teaching innovation.

The most significant benefit of DT-based teaching/learning tools is offering various unconventional innovative tasks to students that develop their problem-solving skills Luka (2014). The tasks may be completed by working in groups, which helps students enhance collaboration and communication skills. Students are motivated to accept unconventional ideas by expressing their opinions and listening to others' opinions, which is a crucial aspect of driving innovation Luka (2014).

Adopting a creative pedagogy in classrooms is the need for the moment to encourage creativity among students Noel and Liub (2017). Creative teachers with their lesson plans, organization of material, inventive teaching methods, and creative assessments can bring novelty to content delivery Veerasinghan et al. (2021). Likewise, a creative pedagogy helps students develop knowledge and skills on the subject as well as develop an attitude towards creativity Starko (2013). Design education imparts non-academic skills among students, which may lay a solid foundation for their future careers Noel and Liub (2017). Skills such as problem-solving, critical thinking, innovation, curiosity, empathy, and collaboration are crucial in this case.

3. REVIEW OF LITERATURE

Various scholars have established how DT can be an effective pedagogical tool in various educational contexts such as K-12 education, engineering education, management courses, medical education, pharmacy education, chemistry education, tourism education, entrepreneurship education, writing studies, and teacher education Thakur et al. (2020), Sandars and Goh (2020), Wolcott and McLaughlin (2020), Sandorova et al. (2020), Wible (2020), Henriksen et al. (2020),

Taajamaa et al. (2013), Withell and Haigh (2013), Ching (2014), Behm (2014), Daniel (2016), Ranger and Mantzavinou (2018), Foster (2021), Kamrowska-Załuska and Parteka (2020), Avsec (2020).

A few studies have empirically proven the applicability of DT to media and communication courses. In one such study, Lugmayr et al. (2014) designed a course for media management students intending to explore new ways of creating ideas and provide a hands-on approach to DT. The Tampere University of Technology organized the course. A total of 11 students participated in the study as two teams. During the course, two different projects were elaborated on with a problem statement. Each team went through the five phases of the DT model to develop creative solutions. The course evidenced that students could apply creative problem-solving methods in their media management projects.

Yang (2018) applied DT to a packaging design course at the Ming Chi University of Technology, Taiwan. The aim was to make students identify problems from the perspectives of packaging design. The teaching outcomes of the case study showed that DT enhanced students' practical experiences, learning motivations, teamwork, and customer orientation. In a subsequent study, Yang and Hsu (2020) studied the influence of DT on the students' creative self-efficacy and flow experience in a packaging design course at the Ming Chi University of Technology. The study employed a pretest-posttest experimental design with a convenience sample of 54 students in 12 creative teams. The findings revealed that the students' creative self-efficacy and flow experience were superior in the posttest than in the pretest.

In a comparative study, Fuente et al. (2019) evaluated the implementation of a DT Project-Based Learning (DTPBL) model across several courses in packaging engineering. DTPBL was implemented in eight quarters in three years. The course outcomes were compared against the Traditional Project-Based Learning (TPBL) approach. DTPBL yielded many more awards than the TPBL, making it a successful pedagogical strategy to improve students' creativity and innovation in packaging solutions.

Liu and Ko (2021) conducted an experimental study to analyse the effects of incorporating social media and DT into a corporate identity design course in Taiwan. The sample comprised 60 students studying 11th grade at a vocational high school. During the study, the experimental group received innovative pedagogy combining Facebook and Line App with DT, and the control group received traditional teaching. The findings showed that students in the experimental group produced better design products than the control group. In another Taiwanese study, Ching-Jung (2021) applied DT to advertising design courses. The experiment recruited 48 students doing an advertising design course and divided them into 13 creative teams. The control group received a traditional lecture, and the treatment group received an innovative method based on DT. The findings revealed that, compared with the control group students, the experimental group students showed greater participation in advertising issues and demonstrated better interaction and effective communication both in the team and with the instructors, which finally improved learning achievements in the course.

A case study by Yilmaz (2021) analysed the effects of DT on the learning experience among communication students at the Northeastern public university. Student teams comprising 30 members solved a real-life problem relating to online privacy, cyberbullying, and digital deception. Student reflections showed that their learning experience is positive in terms of creative problem solving, generating practical knowledge, and engaging in deeper learning and collaborative creativity.

While the previous studies have established the applicability of DT to courses in media and communication disciplines, they haven't answered these two questions. How are DT-based teaching interventions designed and implemented? How and why is DT-based pedagogy more effective than that of previous teaching methods? These questions require further investigations.

3.1. APPLICATION OF OTHER TEACHING METHODS

Earlier studies applied various other teaching methods in the context of media and communication courses. Among them, cooperative learning, service learning, collaborative learning, project-based learning, performance-based learning, and technology-enhanced learning are notable methods. Tsay and Brady (2010) introduced cooperative learning to an undergraduate communication research course at Northeastern University. The findings showed that students' active participation positively impacted their academic performance. Wilson (2012) adopted a service-learning instructional model in a public relations course to enhance critical thinking and problem-solving. The results confirmed that service-learning increased students' abilities such as identifying new information, creative thinking, and real-world problem-solving. Likewise, Moody and Burleson (2013) combined service-based and collaborative learning in the journalism courses at Baylor University. The evaluation showed that students became service-oriented and developed more volunteerism. Larrondo et al. (2021) conducted a case study on virtual collaborative learning in online journalism. The course outcomes showed that the participants had continual virtual coordination and dialogue with team members during the project.

Goh and Kale (2015) embedded a Project-based learning approach to digitizing a traditional journalism course. The results evinced that the approach improved collaboration and critical thinking among students. Similarly, Graham (2018) embedded a project-based learning approach to teaching data journalism. The approach empowered students to create industry-standard work and enhanced their resilience and creative problem-solving. Friesem (2019) applied a project-based learning model to an undergraduate media literacy course. The results supported that the model enhanced students' media literacy skills. Jones et al. (2022) conducted project-based learning that allowed the collaboration of disabled media-makers with students. The pedagogy facilitated creative, collaborative access planning in each production and enhanced students' technical skills and attitude.

Boland and Cameron (2005), employing the performance-based learning as Newspaper Theatre, critically engaged communication students with media coverage of contemporary issues. By assuming fictional roles and using dramatic conventions, students could apply their skills and perform various tasks in a typical newsroom. Matsiola et al. (2019) administered technology-enhanced learning to undergraduate radio journalism students. The findings indicated that students were satisfied with the outcome and the usefulness of the process.

The above outcomes of previous teaching methods applied in media communication studies showed that the approaches were only adequate in developing skills such as collaboration, critical thinking, and problem-solving. However, they are not holistic enough to develop 21st-century skills, especially empathy. Carlgren et al. (2016) observed that empathy is the main attribute of the DT approach. As a learning method, DT uses collaboration to solve real-world problems by considering people's experiences and feedback and applying creativity and communication Ray (2012).

A review of the past studies showed that there is a paucity of comprehensive empirical evidence demonstrating the design, implementation, and effectiveness of a DT-based innovative teaching method for teaching courses in media and communication streams. It leads to the following research questions.

RQ1: How to design and implement a DT-based innovative pedagogy for the Television and Video Production course?

RQ2: How and why the DT-based innovative pedagogy is more effective?

4. RESEARCH DESIGN AND METHODOLOGY

The study adopted an action research method to design, implement and investigate the efficacy of the DT-based innovative teaching method administered to first-year postgraduate electronic media students at the PSG College of Arts & Science, Coimbatore. Action research is a collaborative and participative approach to improving educational practice. It involves action, evaluation, and reflection. As a reflective practice, it gathers evidence to implement change in practices Clark et al. (2020). Like the DT approach, action research is also an iterative process, in which plans are created, implemented, revised, and then implemented Koshy et al. (2010). Hence, the application of the action research method is appropriate in this context. Moreover, the DT as an innovative pedagogy has its advantages. In comparison with other teaching methods, the DT method is innately good for developing empathic creativity, as it keeps the user at the core of any creative process Reinecke (2016).

The research contained four different phases. In the first phase, the researcher identified modules from a Television Production paper that can be delivered using the new pedagogy. The modules - Television production process, Scenery, and Costumes, were chosen for this purpose from the syllabus. In the second phase, the researcher developed an innovative teaching method using a DT approach. A teaching plan was prepared for that purpose (Table 2). During the third phase, the innovative teaching method was introduced in a typical classroom environment. Subsequently, its effectiveness was studied in the last phase. The study was conducted during the odd semester of 2020. A total of 16 students took part in the exercise, and they were divided into four groups, each containing four members. Small groups or Collabs are ideal for DT activities Ray (2012). Each group received chart papers, sticky notes, and crayons.

A systematic observation was done during each stage of the DT activity by the researcher. A checklist (Appendix 1) was used to record the occurrence of specific behaviour during the observation. In the end, post-activity feedback was collected from the participant using a questionnaire containing a 5-point Likert Scale. Data were analysed using Percentage analysis. Besides, in-depth interviews were conducted with participants to get further insights into the DT activity.

4.1. DESIGN AND IMPLEMENTATION OF DT PEDAGOGY

During the design phase, the instructor developed a story idea for an animated sci-fi television series and named it 10000 AD (in short, 10K AD). The idea was kept intentionally unfinished to make student groups refine and develop upon it. Besides, the story idea was set in a fictional world where characters face a lot of challenges to sustain their life. This is to provoke students' problem-solving skills and make them come up with creative solutions to solve the problems that the characters face in that world. Students were given orientation in DT before introducing new pedagogy in the classroom setting. The scenario of the animated TV series is given below.

During the year 10K AD, the earth has become inhospitable to life. Human Population has dwindled to a mere 1 million. Earth crest has become extremely toxic, which has led to the survival of very few animal and plant species. The sky looks dark green colour during sunrise and sunset. But it looks black at noon. Atmospheric Oxygen levels have gone down to just 0.33%. Earth's land area is reduced to 5%. Human beings are making their colonies under the Ocean. That's the only place where they can live. But the oceans' top layers are carrying Hydrocarbons Spills for a depth of about half a Kilometre. So, they need a special vehicle to reach the top of the ocean. Wild Crow is only one Bird species living. There are carnivorous plants (man-eating) on the land. Because of extreme conditions, humans shed all hairs on their bodies and lost their teeth. They eat sea cucumber for their survival. But it is available for just 3 months a year. So, the colonies are forced into starvation. During the days of scarcity, hunting wild crows has become an important activity for people in the colonies.

During the implementation phase, the instructor introduced the unfinished story idea to student groups. They were instructed to refine and develop upon the story idea and offer various creative solutions to solve problems the characters encounter in the animated series. Student groups are asked to pre-visualize things and the characters which appear in the animated TV series. Clear instructions and guidance were given at each stage of implementation.

4.1.1. EMPATHIZE STAGE

The scenario presented above is not analogous to the present world. The first instruction given to student groups was to create a fictional character and christen that a name. In the next step, the instructor asked them to empathize with the character by developing a Character Journey Map (CJM). CJM is originally referred to as 'Customer Journey Map', but the term has been modified to suit the scenario. CJM is an interview or observation-based sticky note technique for mapping the process that someone is going through. With this mapping, design thinkers can empathize with users and eventually understand their needs Punyalikhit (2015). The preparation of CJM involves the students empathizing and reasoning out the typical day of their characters in 10K AD. The main activity that the character does on a day is hunting the wild crow. Student groups chronologically listed out actions that their character does on a typical day in terms of before, during, and after.

Table 2

Table 2 Teaching plan – Design thinking pedagogy

Course -Television and Video Production				
Modules - Television production process, Scenery, and Costumes				
S. No	**Session Name**	**Duration**	**Instructor**	**Learner**
1	Orientation in DT	20 minutes	Introducing students to the DT approach	Receiving an orientation to the DT approach
	Student Team Formation and Instructions	10 Minutes	Formation of student teams and giving them instructions regarding the activity.	Joining the respective groups. Receiving chart paper, crayons, and sticky notes.
	Presentation of scenario 10000 AD (10K AD)	10 minutes	Presenting an ill-defined story idea of an animated sci-fi Television series '10 K AD'.	Clarifying doubts on the activity and story idea.
2	Empathize	30 minutes	Guiding student groups to create a fictional character and empathize with it.	Creating a Character Journey Map based on the story idea, using sticky notes.

3	Define	40 minutes	Instructing student groups to redefine the problems in the scenario '10K AD'.	Finding the root cause of the problem presented in the scenario using the Five Whys technique.
4	Ideate	40 minutes	Leading student groups to a brainstorming session.	Ideating to provide various creative solutions to solve the problems identified in the analyse stage.
5	Prototype	60 minutes	Instructing students to produce prototypes of their solutions, characters, costumes, weapons, vehicles, and sceneries.	Drawing pre-visualization sketches of their solutions, characters, costumes, weapons, vehicles, sceneries.
6	Test	60 minutes	Evaluating the solutions given by student groups in terms of feasibility and creativity.	Receiving feedback from the instructor.

While writing activities relating to the CJM, the instructor asked students to visualize their character's looks, costumes, gears, weapons, and vehicles. Students came up with a lot of innovative ideas. For the character and costumes, the student team 'A' thought of a man 'Norman', wearing a shell costume and a shark's tooth as a weapon. He uses a giant sea turtle as a vehicle to reach the bottom of the oil spills. From there, he swims across oil spills to reach the land for hunting crows. Team B imagined a male character called Pichu. He wears a metal costume made of Titanium. He uses a crow net as a tool to catch crows. Team C imagined the character 'Aristo'. He wears a costume made of synthetic material. The costume also contains an oxygen cylinder embedded. The weapons used are traditional bows and arrows. Team D imagined a male character Hanos. He is the leader of the colony. People who lived in the colonies are divided into various groups such as Divers, Landers, and Magners. Hanos is a 'Magner'. He has some extrasensory powers. He wears an oil-proof costume and uses the bones of birds and animals as weapons.

4.1.2. DEFINE STAGE

During the define stage, students were asked to analyse why hunting is happening as an important activity for men living in 10K AD. The instructor introduced Toyota's Five Whys approach to the student groups. With this approach, design thinkers find the root cause of the problem and protect the process from recurring mistakes and failures Anderson et al. (2011), Card (2016), Serrat (2017). Using this 5 Whys approach, students reasoned that the seasonal availability of sea cucumber and its limited breeding capacity have led to food scarcity. The outcomes of the 5 Whys approach are given hereunder.

1st why - Why do they hunt crows?

2nd why - Why do they need to feed people in the colony?

3rd why - Why is food scarce?

4th why - Why are the sea cucumbers available only in certain seasons?

5th why - Why is sea cucumbers' capacity to breed throughout the year limited?

As the human population is living in colonies, feeding all of them throughout the year has become a challenge. Here the student groups were asked to consider the conflict of interest- when you over-consume sea cucumber and preserve it for non-seasonal days, the species will be endangered. So, the alternative solution is to

catch the crow. But coming out of the sea for hunting crows will be a difficult task and a life-threatening affair because of the hazardous nature of the land. To solve this problem, student teams were led to the next stage 'Ideate'.

4.1.3. IDEATE STAGE

During the ideate stage, the instructor guided student teams to a brainstorming session to solve the food scarcity problem that persists during 10K AD. Student teams ideated upon it and came up with a lot of creative solutions. Each team presented their ideas and in one such solution, Team B introduced Artificial Intelligence as a solution to catch crows. They invented a weapon called I-weapon. It was a crow net with artificial intelligence (AI). It could catch crows on its own without human interventions. Besides, they also created an AI crow. With that, they collected seeds from the land and do agriculture in laboratories. Team B also suggested the idea of breeding sea cucumbers in the laboratories.

Team C provided an interesting solution where the surplus sea cucumbers caught during seasonal days were preserved for the future. In another solution, Team C introduced the idea of finding out other land creatures such as edible plants and animals apart from wild crows. Team A came up with ideas such as hunger suspending capsules, cold storage of excessive sea cucumbers caught during seasonal days and harvesting the man-eating plants to consume as food. Team D introduced ideas such as improving hunting methods and capturing crows abundantly with baits.

4.1.4. PROTOTYPE STAGE

During the prototype stage, the instructor asked student teams to produce prototypes of their solutions. A prototype can be a sketch or a small two or three-dimensional model made with various materials like paper, cardboard, or clay Carroll et al. (2010). Students drew pre-visualization sketches of solutions that they had thought of for the food scarcity problem. Besides, students also drew pre-visualization sketches of the characters, costumes, weapons, vehicles, and sceneries. These sketches were suggestive of how things might appear in the animated TV series 10K AD.

4.1.5. TESTING STAGE

During the testing stage, testing of the proposed solutions was done. The instructor assumed the role of the expert to find out whether the solutions provided by the four teams were creative and workable. The solutions were analysed, and suggestions were given to the students. The conflict-of-interest approach was used to analyse the best creative solutions.

Testing revealed that Team B's solutions such as introducing I-weapon to catch crows, and breeding sea cucumber in laboratories were creative as well as feasible. The use of I weapons seemed to be the best solution because it solved the problem of men hunting on hazardous land. The breeding of sea cucumber also solved the problem of its limited availability in certain seasons. Through breeding, sea cucumbers can be made available throughout the year. Team C's solution, preservation of surplus sea cucumbers caught during seasonal days, was creative but it failed in practicability. The problem was how much surplus sea cucumber one should get to preserve it for the remaining nine months of scarcity. But with the idea of finding out other land creatures such as edible plants and animals apart from wild

crows, team C went a little out of the box to find out a solution that is creative as well as feasible.

Team A's solution, consuming carnivorous plants, endured both creativity and feasibility tests. Apart from catching crows for food, this would be an alternate solution for the colonies. Team A's other creative solutions such as hunger suspending capsules, and cold storage of excessive sea cucumbers caught during seasonal days, failed in the feasibility test. Though capsules seemed to be a creative solution, consuming the same to suspend one's hunger was not always feasible. Cold storage of surplus sea cucumbers was not feasible because it was already scarce. Catching too much sea cucumber for cold storage might lead to the extinction of the species. Team D presented solutions that were highly feasible but conventional in approach. Improving hunting methods and capturing crows abundantly with baits were not creative in approach.

5. FINDINGS AND DISCUSSION

The study systematically observed each stage of implementing the DT pedagogy. Besides, the findings of in-depth interviews and post-activity feedback provided more insights. For interpreting the results of the in-depth interviews, the study named students - A, B, C…, and P. Following are the outcomes of the learning process.

5.1. APPLYING EMPATHY TO UNDERSTAND THE NATURE OF THE PROBLEM

The observations made during the empathize stage showed that students could create fictional characters and develop upon the ill-defined story idea. They could empathize with the characters by putting themselves in their situation. It was evident in their character journey map (CJM). In CJM, students mapped their character's daily routine in three different time sets: before, during, and after. This empathic process helped them to understand the true nature of the problem present in the scenario.

While reflecting on the empathy stage during the in-depth interview, students opined that they could establish an empathic connection with the character. "I have been able to visualize myself in the place of my character. It helps map the character's journey," said Student A. Likewise, Student D said, "Empathizing has enabled us to relate to the world of the character which differs from ours." When talking about the benefits of the empathy stage, Student N commented, "With empathy, it is easy for us to see things from the character's point of view. We could recognize the nature of the problem and refine the ambiguous story idea."

These findings aligned with student feedback. Most students strongly agreed that they could gain an empathic understanding of the scenario presented in the activity (88%) and visualize a world and characters that are not like theirs (94%).

5.2. FINDING THE ROOT CAUSE OF THE PROBLEM USING CRITICAL THINKING

In the define stage, students used their critical thinking skills to analyse the root cause of the food scarcity problem presented in the scenario. It all started with the question, "Why do they hunt crows?" Using the Five Whys approach, they were able to redefine the problem from a human-centric angle. They found that the limited breed capacity of sea cucumber was the reason for it.

In-depth interviews of students showed that the define stage organized their analytical thinking. Student G said, "The Five Whys approach is useful in discovering the root cause of the problem in a step-by-step manner." Adding to that, student B said, "We usually make random guesses to find out the root cause of the problem. But the Five Whys approach is systematic."

Feedback from the students also confirmed the usefulness of the Five Whys approach. Most students (88%) strongly agreed that they were able to analyse and locate the root cause of the problem.

5.3. DEVELOPING CREATIVE SOLUTIONS THROUGH IDEATION TECHNIQUES

During the ideate stage, students brainstormed and proposed various creative solutions. In the student feedback, most students (88%) strongly agreed that they were able to ideate and offer many creative solutions through brainstorming. The observations established that the students could use their problem-solving skills and creativity in idea generation. Each team gathered a list of ideas generated spontaneously by its team members. They evaluated and improved upon their ideas to make them innovative and workable.

Students expressed positive views about the ideation process in their in-depth interviews. "In the ideate stage, we generated many ideas in a short amount of time," claimed Student K. Similarly, Student L said, "There is no shortage of ideas. With the involvement of our team members, we could generate a lot of them." Student N remarked on the collaborative nature of the ideation process. "We listened to each other in the team while developing solutions in the ideate stage. We thought of various possibilities and exchanged our views with each one in the team."

5.4. DESIGNING PROTOTYPES OF SOLUTIONS AS PRE-VISUALIZATION SKETCHES

During the prototype stage, the study observed that students could design the prototypes of their solutions as pre-visualization sketches. Prototyping helped them to bring out their creative ideas visually. The feedback also affirmed it, in which most students (94%) strongly agreed that they could pre-visualize sceneries, characters, costumes, gears, vehicles, and solutions to the scenario given in the DT activity.

Interview data showed that the students saw prototyping as a method of giving shape to their ideas. "Designing prototypes feels like bringing life to our ideas," opined Student M. Adding to that, Student P said, "Prototyping helped us to identify mistakes and improve our solutions." Likewise, Student J claimed, "It eliminated vagueness and communication gaps in solution providing."

5.5. EXHIBITING DT MIND-SET

In the test stage, the instructor evaluated the prototypes and briefed students about their merits and demerits. The in-depth interviews revealed that students positively received the instructor's feedback. Student C commented, "The instructor's feedback was useful in realising the strengths and weaknesses of our prototypes." In the same way, Student H admitted, "The activity encouraged me to learn from the mistakes. It has altered the way I see problems. Now I consider them as opportunities." Subsequently, Student E asserted, "DT has given me the

confidence to solve problems creatively." This finding was in line with the feedback in which most students (94%) were highly confident that with DT, the vague idea of an animated sci-fi television series can be refined, prototyped, and tested.

Overall, the findings gathered during the DT activity suggested that students showed the traits of a DT mind-set. Because the traits such as empathy, learning from failures, experimenting with prototypes, optimism, embracing ambiguity, creative confidence, and iterations are the intrinsic aspects of a DT process Design Kit (n.d.).

5.6. ENGAGING IN COLLABORATIVE COMMUNICATION WITH TEAM MEMBERS

The whole process of teaching and learning was a highly collaborative learning atmosphere. The exchange of ideas occurred in both instructor-learner and peer-to-peer settings. In-depth interviews revealed that group members showed openness and had opportunities to express their diverse views. Student O divulged, "I usually suppress my opinion because of my lack of confidence. But the nature of the activity made me collaborate with others and express my views openly." Likewise, Student I commented, "Being part of a small group allowed me to express my views as well as listen to others." Student feedback also reflected the same. Most students (88%) strongly agreed that the activity facilitated effective communication among team members, and they could provide solutions collaboratively.

5.7. IMPLEMENTATION OF DT-BASED PEDAGOGY: CHALLENGES

The findings revealed that there were some challenges in implementing the DT-based pedagogy. Despite receiving orientation at the start, students felt that the whole process was relatively difficult. Besides, the transition from the traditional learning approach to DT-based experiential learning was challenging and time-consuming. "Initially, it was difficult for me to adapt to the DT process. The orientation just helped me to understand the steps, but the instructions given at regular intervals helped me to go through each stage with fewer difficulties," opined Student P. Correspondingly, Student K commented, "It took more time for me to understand various steps. At first, it was confusing, but later with the guidance it became an enjoyable learning experience." Hence, the instructor has an important role in providing adequate guidance to students to overcome the implementation challenges.

The above findings made during the implementation phase substantiate that DT pedagogy has been more effective in imparting essential skills such as empathy, critical thinking, problem-solving, collaborative skills, creativity, and innovation. Hence, the study infers that, compared to previous teaching approaches adopted in the media and communication discipline, DT is a more comprehensive approach.

6. RECOMMENDATIONS

The findings suggest that DT can be used as an innovative teaching method to teach subjects in media and communication courses. The study also evidenced that it is effective in providing key competencies for 21st-century learners. It provides learners with a highly collaborative learning environment. So, it is ideal for courses that demand skills such as empathy, critical thinking, problem-solving, collaborative

skills, creativity, and innovation. Educational institutions may adopt DT as a part of their teaching strategy to enhance their curriculum delivery.

Incorporating DT into the existing curriculum and teaching plan was a challenging task. Since the DT activity was a rather time-consuming process than conventional classroom teaching. It required more teaching hours than usual. So, instructors may consider the time constraints associated with DT pedagogies while preparing their teaching plans. Besides, instructors may adopt the teaching plan (Table 1) given in this study with more or few modifications, depending upon the requirements of the course they teach.

For the better implementation of this innovative teaching method, instructors need prior knowledge and experience in the DT. In such cases, they may learn DT through books, courses, workshops, seminars, etc.

As the study sample comprises 16 postgraduate students, the findings were not generalizable. However, the outcomes may help future studies to design and execute a DT-based pedagogy. The formation of small groups is ideal for DT exercises because it gives opportunities for every group member to express their views, which contributes to peer-learning through teamwork and collaboration.

7. SUGGESTIONS FOR IMPROVEMENT

The study conducted this DT activity in a highly collaborative environment with four teams of students. The process took four and a half hours duration during the first iteration. With multiple iterations, the same activity may yield better results in terms of students coming up with better solutions and prototypes. Future studies may investigate the cross-domain efficacy of DT-based pedagogy. Further, the modalities of delivering an online-based DT pedagogy need to be studied.

8. CONCLUSION

With changing business environments, the sustainability of media organizations depends on their business and operational innovations. Since conventional classroom practices no longer meet the industry talent requirements, adopting innovative teaching methods that impart 21st-century skills is highly encouraged at schools and higher educational institutions. Hence, the study conducted the action research to introduce a DT- based teaching innovation in teaching a few modules of a course 'Television and Video Production'. The study aims to show how to design, implement, and establish how and why the DT-based innovative teaching method is more effective. The findings demonstrated that DT is a holistic approach to media and communication courses as it helps impart skills such as empathy, critical thinking, problem-solving, collaboration, creativity, and innovation.

CONFLICT OF INTERESTS

None.

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REFERENCES

Anderson, J. S., Morgan, J. N., & Williams, S. K. (2011). Using Toyota's A3 Thinking for Analyzing MBA Business Cases. Decision Sciences Journal of Innovative Education, 9(2), 275-285. https://doi.org/10.1111/j.1540-4609.2011.00308.x.

Avsec, S. (2020). Investigation into Design Thinking in Mechanical Engineering Students. World Transactions on Engineering and Technology Education, 18(2), 91-96.

Badillo, P. Y., & Bourgeois, D. (2020). Innovation and Media : Googlization and Limited Creativity. the Industrialization of Creativity and its Limits, 189-204. https://doi.org/10.1007/978-3-030-53164-5_13.

Beckman, S.L., & Barry, M. (2007). Innovation as à Learning Process : Embedding Design Thinking. California Review Management, 50(1), 25-56. https://doi.org/10.2307/41166415.

Behm, M., Culvenor, J., & Dixon, G. (2014). Development of Safe Design Thinking Among Engineering Students. Safety Science, 63, 1-7. https://doi.org/10.1016/j.ssci.2013.10.018.

Beligatamulla, G., Rieger, J., Franz, J., & Strickfaden, M. (2019). Making Pedagogic Sense of Design Thinking in the Higher Education Context. Open Education Studies, 1(1), 91-105. https://doi.org/10.1515/edu-2019-0006.

Bleyen, V. A., Lindmark, S., Ranaivoson, H., & Ballon, P. (2014). A Typology of Media Innovations : Insights From an Exploratory Study. The Journal of Media Innovations, 1(1), 28-51. https://doi.org/10.5617/jmi.v1i1.800.

Boland, G., & Cameron, D. (2005). Newspaper Theatre : Applying Performance-Based Learning to Journalism Education. In Journalism Education Association (JEA) Conference. Griffith University, 1-20.

Bowler, L. (2014). Creativity Through "Maker" Experiences and Design Thinking in the Education of Librarians. Knowledge Quest, 42(5), 58–61.

Brenner, W., & Uebernickel, F. (2016). Design Thinking for Innovation. Research and Practice. Springer, Berlin, Heidelberg.

Bross, J., Acar, A. E., Schilf, P., & Meinel, C. (2009). Spurring Design Thinking Through Educational Weblogging. In Computational Science and Engineering. CSE'09. International Conference. IEEE, 4, 903–908.

Carlgren, L., Rauth, I., & Elmquist, M. (2016). Framing Design Thinking : the Concept in Idea and Enactment. Creativity and Innovation Management, 25(1), 38–57. https://doi.org/10.1111/caim.12153.

Carroll, M., Goldman, S., Britos, L., Koh, J., Royalty, A., & Hornstein, M. (2010). Destination, Imagination and the Fires Within : Design Thinking in a Middle School Classroom. International Journal of Art & Design Education, 29(1), 37-53. https://doi.org/10.1111/j.1476-8070.2010.01632.x.

Çeviker-Çınar, G., Mura, G., & Demirbağ-Kaplan, M. (2017). Design Thinking : A new Road Map in Business Education. The Design Journal, 20(sup1), S977-S987. https://doi.org/10.1080/14606925.2017.1353042.

Ching, H. Y. (2014). Design Thinking in Classroom : An Experience with Undergrad Students of a Business Course. Business and Management Research, 3(2), 110-119. https://doi.org/10.5430/bmr.v3n2p110.

Ching-Jung, F. (2021). Design Thinking Applied to Advertising Design Courses to Enhance Students' Learning Achievement. The Southeast Asian Conference on Education 2021 Official Conference Proceedings. https://doi.org/10.22492/issn.2435-5240.2021.7.

Clark, J. S., Porath, S., Thiele, J., and Jobe, M. (2020). Action Research. NPP eBooks. New Prairie Press, Kansas State University Libraries. 34.

Conklin, W. (2011). Higher-Order Thinking Skills to Develop 21st Century Learners. Teacher Created Materials.

Cook, K. L., & Bush, S. B. (2018). Design Thinking in Integrated STEAM Learning: Surveying the Landscape and Exploring Exemplars in Elementary Grades. School Science and Mathematics, 118(3-4), 93-103. https://doi.org/10.1111/ssm.12268.

Daly, S. R., Seifert, C. M., Yilmaz, S., & Gonzalez, R. (2016). Comparing Ideation Techniques for Beginning Designers. Journal of Mechanical Design, 138(10). https://doi.org/10.1115/1.4034087.

Dam, R., & Siang, T. (2018). What is Design Thinking and Why is it So Popular. Interaction Design Foundation.

Dam, R.F. (n.d). 5 Stages in the Design Thinking Process. Interaction Design Foundation.

Daniel, A. D. (2016). Fostering an Entrepreneurial Mindset by Using a Design Thinking Approach in Entrepreneurship Education. Industry and Higher Education, 30(3), 215-223. https://doi.org/10.1177/0950422216653195.

De la Fuente, J., Carbonell, I., & LaPorte, M. (2019). Design Thinking as à Framework for Teaching Packaging Innovation. Journal of Applied Packaging Research, 11(1), 4.

Design Kit. (n.d.). Mindsets.

Deutschmann M., and Botts M. (2015). Experiential Learning through the Design Thinking Technique. In : Taras V., Gonzalez-Perez M.A. (eds) The Palgrave Handbook of Experiential Learning in International Business. Palgrave Macmillan, London. https://doi.org/10.1057/9781137467720_26.

Dolak, F., Uebernickel, F., & Brenner, W. (2013). Design Thinking and Design Science Research. Institute of Information Management, University of St. Gallen, HSG/IWI, 1-11.

Elsbach, K. D., & Stigliani, I. (2018). Design Thinking and Organizational Culture : A Review and Framework for Future Research. Journal of Management, 44(6), 2274-2306. https://doi.org/10.1177%2F0149206317744252.

Ferguson, R., Coughlan, T., Egelandsdal, K., Gaved, M., Herodotou, C., Hillaire, G., ... & Whitelock, D. (2019). Innovating Pedagogy 2019 : Open University Innovation Report 7. Retrieved August 6, 2021.

Foster, M. K. (2021). Design Thinking : A Creative Approach to Problem Solving. Management Teaching Review, 6(2), 123-140. https://doi.org/10.1177%2F2379298119871468.

Friedrichsen, M., Kamalipour, Y. R., & Kamalipour, Y. (2017). Digital Transformation in Journalism and News Media. Springer.

Friesem, Y. (2019). Teaching Truth, Lies, and Accuracy in the Digital Age : Media Literacy as Project-Based Learning. Journalism & Mass Communication Educator, 74(2), 185–198. https://doi.org/10.1177%2F1077695819829962.

Garrette, B., Phelps, C., & Sibony, O. (2018). Structure and Solve the Problem Using Design Thinking. In Cracked it ! Palgrave Macmillan, Cham. 169-195.

Gaskin, J., & Berente, N. (2011). Video Game Design in the MBA Curriculum : An Experiential Learning Approach for Teaching Design Thinking. Communications of the Association for Information Systems, 29(1), 6. https://doi.org/10.17705/1CAIS.02906.

Goh, D., & Kale, U. (2015). From Print to Digital Platforms : A PBL Framework for Fostering Multimedia Competencies and Consciousness in Traditional

Journalism Education. Journalism & Mass Communication Educator, 70(3), 307–323. https://doi.org/10.1177%2F1077695815589473.

Graham, C. (2018). A DIY, Project-Based Approach to Teaching Data Journalism. Asia Pacific Media Educator, 28(1), 67–77. https://doi.org/10.1177%2F1326365X18768308.

Gross, K., & Gross, S. (2016). Transformation : Constructivism, Design Thinking, and Elementary STEAM. Art Education, 69(6), 36-43.

Guvenir, C., & Bagli, H. H. (2020). The Potentials of Learning Object Design in Design Thinking Learning. Markets, Globalization & Development Review, 4(2).

Henriksen, D., Gretter, S., & Richardson, C. (2020). Design Thinking and the Practicing Teacher : Addressing Problems of Practice in Teacher Education. Teaching Education, 31(2), 209-229. https://doi.org/10.1080/10476210.2018.1531841.

Herodotou, C., Sharples, M., Gaved, M., Kukulska-Hulme, A., Rienties, B., Scanlon, E., & Whitelock, D. (2019). Innovative Pedagogies of the Future : An Evidence-Based Selection. Frontiers in Education 4, 113. Frontiers. https://doi.org/10.3389/feduc.2019.00113.

Jacobs, C. D. (2016). "Making Is Thinking" : The Design Practice of Crafting Strategy. In Design Thinking for Innovation. 131-140. Springer, Cham. https://doi.org/10.1007/978-3-319-26100-3_9.

Jones, C. T., Collins, K., & Zbitnew, A. (2022). Accessibility as Aesthetic in Broadcast Media : Critical Access Theory and Disability Justice as Project-Based Learning. Journalism & Mass Communication Educator, 77(1), 24–42. https://doi.org/10.1177%2F10776958211000198.

Kamrowska-Załuska, D. D., & Parteka, T. (2020). Design Thinking (DT) for the Design and Planning Education of Engineer-Architects. World Transactions on Engineering and Technology Education, 18(2), 97-101.

Kijima, R., Yang-Yoshihara, M. & Maekawa, M.S. (2021). Using Design Thinking to Cultivate the Next Generation of Female STEAM Thinkers. International Journal of STEM Education. 8(14). https://doi.org/10.1186/s40594-021-00271-6.

Kloeckner, A. P., Libânio, C. D. S., & Ribeiro, J. L. D. (2017). Design Thinking Methods and Techniques in Design Education. In DS 88 : Proceedings of the 19th International Conference of Engineering and Product Design Education (E&PDE17), Building Community : Design Education for a Sustainable Future, Oslo, Norway, 7 & 8 September 2017. 537-542.

Koh, J. H. L., Chai, C. S., Wong, B., & Hong, H. Y. (2015). Design Thinking and Education. In Design Thinking for Education. Singapore : Springer 1-15.

Koshy, E., Koshy, V., & Waterman, H. (2010). Action Research in Healthcare. Sage. https://dx.doi.org/10.4135/9781446288696.

Küng, L. (2013). Innovation, Technology and Organisational Change : Legacy Media's Big Challenges : An Introduction. In Media Innovations : A Multidisciplinary Study of Change, 9–12.

Larrondo Ureta, A., Peña Fernández, S., & Fernandes Teixeira, J. (2021). Online Journalism Teaching and Learning Processes Beyond the Classroom and the University : Experiences in International Virtual Collaboration on Multimedia Projects. Journalism & Mass Communication Educator, 76(1), 5-28. https://doi.org/10.1177%2F1077695820916620.

Liedtka, J. (2015). Perspective : Linking Design Thinking with Innovation Outcomes Through Cognitive Bias Reduction. Journal of Product Innovation Management, 32(6), 925–938. https://doi.org/10.1111/jpim.12163.

Liu, G.C., & Ko, C.H. (2021). Effects of Social Media and Design Thinking on Corporate Identity Design Course in Taiwan. E-Learning and Digital Media, 18(3), 251–268. https://doi.org/10.1177%2F2042753020950879.

Lugmayr, A., Stockleben, B., Zou, Y., Anzenhofer, S., & Jalonen, M. (2014). Applying "Design Thinking" in the Context of Media Management Education. Multimedia Tools and Applications, 71(1), 119-157. https://doi.org/10.1007/s11042-013-1361-8.

Luka, I. (2014). Design Thinking in Pedagogy. The Journal of Education, Culture, and Society, 5(2), 63-74. https://doi.org/10.15503/jecs20142.63.74.

Matsiola, M., Spiliopoulos, P., Kotsakis, R., Nicolaou, C., & Podara, A. (2019). Technology-Enhanced Learning in Audiovisual Education : The Case of Radio Journalism Course Design. Education Sciences, 9(1), 62. https://doi.org/10.3390/educsci9010062.

Matthews, J. H., & Wrigley, C. (2017). Design and Design Thinking in Business and Management Higher Education. Journal of Learning Design, 10(1), 41–54. http://dx.doi.org/10.5204/jld.v9i3.294.

Moody, M., & Burleson, C. (2013). Using Service-Based, Collaborative Teaching in Journalism Courses. Teaching Journalism and Mass Communication, 3(2).

Noel, L. A., & Liub, T. L. (2017). Using Design Thinking to Create a New Education Paradigm for Elementary Level Children for Higher Student Engagement and Success. Design and Technology Education, 22(1), 1-12.

Owen, C. (2007). Design Thinking : Notes on its Nature and Use. Design Research Quarterly, 2(1), 16-27.

Pande, M., & Bharathi, S. V. (2020). Theoretical Foundations of Design Thinking–A Constructivism Learning Approach to Design Thinking. Thinking Skills and Creativity, 36. https://doi.org/10.1016/j.tsc.2020.100637.

Panke, S. (2019). Design Thinking in Education : Perspectives, Opportunities and Challenges. Open Education Studies, 1(1), 281-306. https://doi.org/10.1515/edu-2019-0022.

Peck, A., & De Sawal, D. (2021). Applying Design Thinking to the Measurement of Experiential Learning. IGI Global.

Plattner, H., Meinel, C., & Weinberg, U. (2011). Design-Thinking- Understand-Improve-Apply. Springer, Berlin, Heidelberg.

Ponnan, R., & Ambalavanan, B. (2014). Innovations to Broadcasting Curriculum to Meet Workplace Expectations. Procedia-Social and Behavioral Sciences, 123, 160-169. https://doi.org/10.1016/j.sbspro.2014.01.1410.

Punyalikhit, R. (2015). Empathy and Emotional Customer Journey Map Methods : for Designing Creative Learning Space. Veridian E-Journal, Silpakorn University (Humanities, Social Sciences and Arts), 8(5), 35-58.

Pusca, D., & Northwood, D. O. (2018). Design Thinking and its Application to Problem Solving. Global Journal of Engineering Education, 20(1), 48-53.

Ranger, B. J., & Mantzavinou, A. (2018). Design Thinking in Development Engineering Education : A Case Study on Creating Prosthetic and Assistive Technologies for the Developing World. Development Engineering, 3, 166-174. https://doi.org/10.1016/j.deveng.2018.06.001.

Rauth, L, Kippen, E., Jobst, B., & Meinel, C. (2010). Design Thinking : An Educational Model Towards Creative Confidence. Proceedings of the 1st International Conference of Design Creativity (ICDC 2010).

Ray, B. (2012). Design Thinking : Lessons for the Classroom.

Reinecke, S. (2016). What is it that Design Thinking and Marketing Management can Learn from Each Other ? In Design Thinking for Innovation. Springer, 151-162. https://doi.org/10.1007/978-3-319-26100-3_11.

Sandars, J., & Goh, P. S. (2020). Design Thinking in Medical Education : The Key Features and Practical Application. Journal of Medical Education and Curricular Development, 7. https://doi.org/10.1177%2F2382120520926518.

Sandorova, Z., Repanova, T., Palencikova, Z., & Betak, N. (2020). Design Thinking-A Revolutionary New Approach in Tourism Education ? Journal of Hospitality, Leisure, Sport & Tourism Education, 26, 100238. https://doi.org/10.1016/j.jhlste.2019.100238.

Scheer, A., Noweski, C., & Meinel, C. (2012). Transforming Constructivist Learning into Action : Design Thinking in Education. Design and Technology Education : An International Journal, 17(3), 8-19.

Seechaliao, T. (2017). Instructional Strategies to Support Creativity and Innovation in Education. Journal of Education and Learning, 6(4), 201-208. http://doi.org/10.5539/jel.v6n4p201.

Serrat, O. (2017). The Five Whys Technique. Knowledge Solutions. Springer, 307-310. https://doi.org/10.1007/978-981-10-0983-9_32.

Simon. H. A. (1969). The Sciences of the Artificial (1st ed.). Cambridge MA : MIT Press.

Spanjaard, D., Hall, T., & Stegemann, N. (2018). Experiential learning : Helping Students to Become 'Career-Ready'. Australasian Marketing Journal (AMJ), 26(2), 163-171. https://doi.org/10.1016%2Fj.ausmj.2018.04.003.

Starko, A. J. (2013). Creativity in the Classroom : Schools of Curious Delight. Routledge.

Stock, K. L., Bucar, B., & Vokoun, J. (2018). Walking in Another's Shoes: Enhancing Experiential Learning Through Design Thinking. Management Teaching Review, 3(3), 221-228. https://doi.org/10.1177/2379298117736283.

Taajamaa, V., Kirjavainen, S., Repokari, L., Sjöman, H., Utriainen, T., & Salakoski, T. (2013). Dancing With Ambiguity Design Thinking in Interdisciplinary Engineering Education. in 2013 IEEE Tsinghua International Design Management Symposium. IEEE, 353-360. https://doi.org/10.1109/TIDMS.2013.6981258.

Thakur, A., Soklaridis, S., Crawford, A., Mulsant, B., & Sockalingam, S. (2020). Using Rapid Design Thinking to Overcome COVID-19 Challenges in Medical Education. Academic Medicine. https://doi.org/10.1097/ACM.0000000000003718.

Trilling, B., & Fadel, C. (2009). 21st Century Skills : Learning for Life in our Times. San Francisco : Josseybass.

Tsay, M., & Brady, M. (2010). A Case Study of Cooperative Learning and Communication Pedagogy : Does Working in Teams Make A Difference ? Journal of the Scholarship of Teaching and Learning, 10(2), 78-89.

Valentim, N. M. C., Silva, W., & Conte, T. (2017). The Students' Perspectives on Applying Design Thinking for the Design of Mobile Applications. In Proceedings of the 39th International Conference on Software Engineering : Software Engineering and Education Track. IEEE Press, 77–86. https://doi.org/10.1109/ICSE-SEET.2017.10.

Veerasinghan, K., Balakrishnan, B., Ibrahim, M., Damanhuri, M., & Gengatharan, K. (2021). Design Thinking for Creative Teaching of Chemistry. Social Sciences, 11(3), 670-687. https://doi.org/10.6007/IJARBSS%2FV11-I3%2F8979.

Von Thienen, J., Royalty, A., & Meinel, C. (2017). Design Thinking in Higher Education : How Students Become Dedicated Creative Problem Solvers. In Handbook of Research on Creative Problem solving Skill Development In Higher

Education, 306–328. IGI Global. https://doi.org/10.4018/978-1-5225-0643-0.ch014.
Wallin, J., Isaksson, O., Larsson, A., & Elfström, B. O. (2014). Bridging the Gap Between University and Industry: Three Mechanisms for Innovation Efficiency. International Journal of Innovation and Technology Management, 11(01). https://doi.org/10.1142/S0219877014400057.
Watson, A. D. (2015). Design Thinking for Life. Art Education, 68(3), 12–18. https://doi.org/10.1080/00043125.2015.11519317.
Weiss, A. S., De Macedo Higgins Joyce, V. A. N. E. S. A., Harlow, S., & Alves, R. C. (2018). Innovation and Sustainability : A Relationship Examined Among Latin American Entrepreneurial News Organizations. Cuadernos. Info, (42). http://dx.doi.org/10.7764/cdi.42.1266.
Wible, S. (2020). Using Design Thinking to Teach Creative Problem Solving in Writing Courses. College Composition and Communication, 71(3), 399-425.
Wilson, B. (2012). An Experiential Approach to Improving Students' Critical-Thinking and Problem-Solving Skills. Teaching Public Relations Monographs, 83, 1-4.
Withell, A. J., & Haigh, N. (2013). Developing Design Thinking Expertise in Higher Education. International Conference for Design Education Researchers.
Wolcott, M. D., & McLaughlin, J. E. (2020). Promoting Creative Problem-Solving in Schools of Pharmacy With the Use of Design Thinking. American Journal of Pharmaceutical Education, 84(10). https://doi.org/10.5688/ajpe8065.
Yang, C. M. (2018). Applying Design Thinking as à Method for Teaching Packaging Design. Journal of Education and Learning, 7(5), 52-61. https://doi.org/10.5539/jel.v7n5p52.
Yang, C. M., & Hsu, T. F. (2020). Integrating Design Thinking into a Packaging Design Course to Improve Students' Creative Self-Efficacy and Flow Experience. Sustainability, 12(15). https://doi.org/10.3390/su12155929.
Yilmaz, G. (2021). Revitalizing the Communication Classroom : A Case of Design Thinking. Communication Teacher, 1-18. https://doi.org/10.1080/17404622.2021.1962934.

APPENDIX

Appendix 1

Appendix 1 Observation checklist for DT-based innovative pedagogy

S. No	Criteria	Yes	No	Remarks
1	Creating characters from the ill-defined story idea			
2	Developing the world of the characters			
3	Creation of character's looks, costumes, gears, weapons, and vehicles based on their imagination			
4	empathizing with characters while doing the character Journey Mapping			
5	Identifying the problem present in the characters' world			
6	Finding the root cause of the problem			
7	Proposing innovative solutions to solve the problem			
8	Evaluating the solutions for problem-solving			
9	Presenting solutions as prototypes			
10	Collaboration among team members			